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ABSTRACT

This instructor's guide, designed for use with the curriculum, Plant Operations for Wastewater Facilities, represents a two-year wastewater technology instructional program based on performance objectives designed to prepare undergraduate students to enter occupations in water and wastewater treatment plant operations and maintenance. This document, part A of five parts, covers the topics of Collection, Chlorination, Screening and Grinding, Grit Removal and Primary Sedimentation. In this guide, the topics and ideas are presented as a series of modules, organized around 16 general objectives common to all processes. The module begins with a statement of purpose which explains what the student will be studying. Next, all the objectives of the module and code numbers keyed to a computerized list of instructional resources are listed. Also included in each module are a glossary of verbs and sections on learning and testing conditions, acceptable performance, instructor activity and student activity. Recommendations on evaluation techniques are included. (BT)

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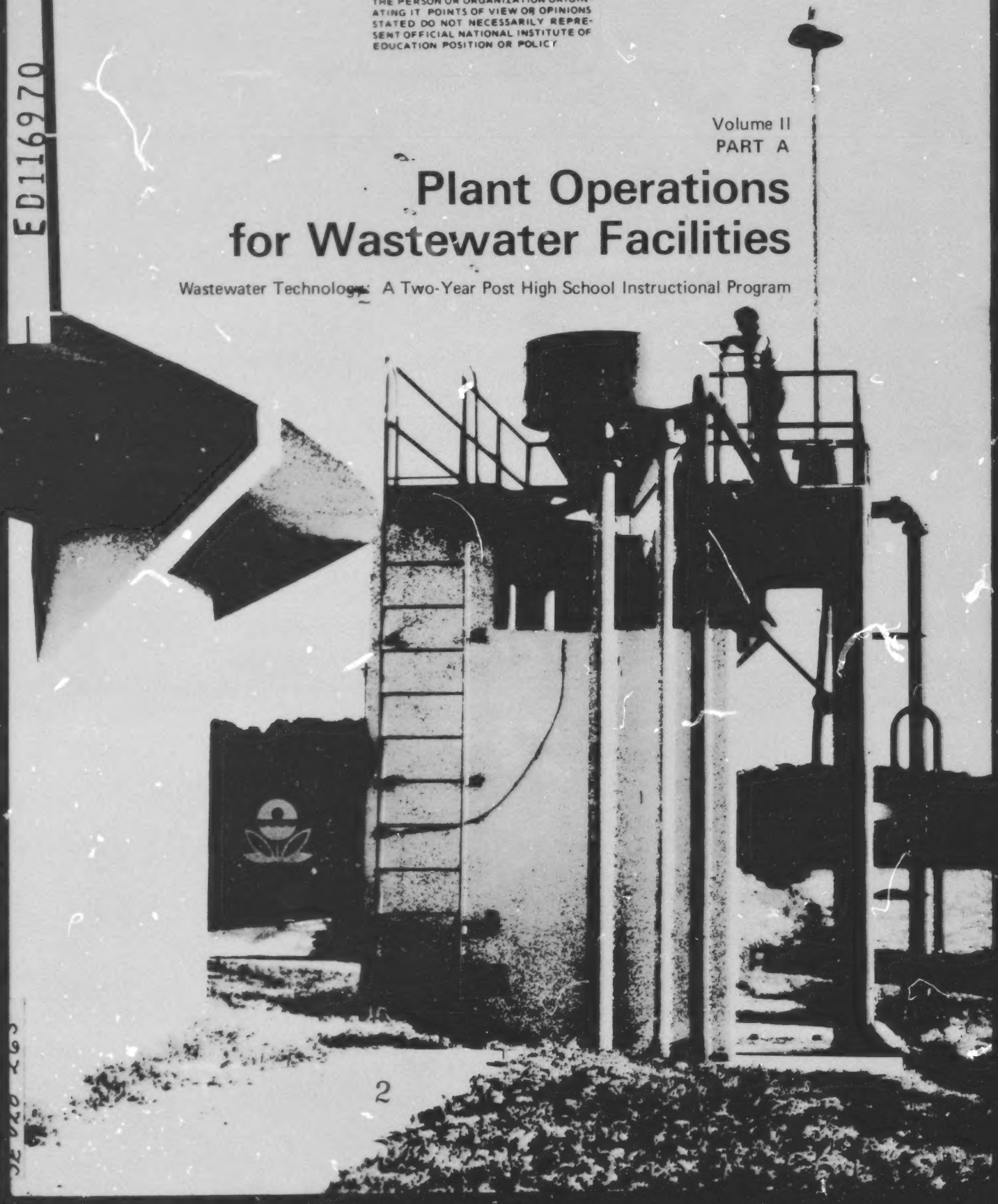
Volume II
PART A

Plant Operations for Wastewater Facilities

Wastewater Technology: A Two-Year Post High School Instructional Program



PLANT OPERATIONS FOR WASTEWATER FACILITIES, Part A

Collection
Chlorination
Screening and Grinding
Grit Removal
Primary Sedimentation

An Instructor's Guide for Use of Instructional Material
In Wastewater Technology Training Programs

Funded by

US ENVIRONMENTAL PROTECTION AGENCY
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Water Quality Control Manpower Training Branch
Academic Training Section

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Preface

Since 1970 Charles County Community College, Clemson University, Greenville Technical College and Linn-Benton Community College have been working together to prepare undergraduate students to enter occupations in water and wastewater treatment plant operations and maintenance. Through their efforts a two-year wastewater technology instructional program based on performance objectives has been developed and implemented.

Through a grant from the Environmental Protection Agency called *Criteria for the Establishment of Two-Year Post High School Wastewater Technology Programs (CEWT)* the four colleges set up program criteria and curriculum guidelines which are available in two volumes:

Program Implementation Procedures
Volume II: Curriculum Guidelines, Criteria for Establishment and Maintenance of Two-Year Post High School Wastewater Technology Programs

As a result of the implementation of the instructional program at Charles County Community College, Greenville Technical College and Linn-Benton Community College, six guides for instructors based on the course descriptions in *Plant Implementation Procedures* and the general criterion behaviors of *Volume II* have been prepared. *Plant Operations for Wastewater Facilities*, printed in five parts, is the second in the series which includes:

Volume I *Introduction to Environmental Technology*
Volume II *Plant Operations for Wastewater Facilities*
Volume III *Laboratory Control for Wastewater Facilities*
Volume IV *Management and Supervision Procedures for Wastewater Facilities*
Volume V *Process Interaction for Wastewater Facilities*
Volume VI *Advanced Waste Treatment*

ACKNOWLEDGEMENTS

Since the beginning of the project many persons at the four cooperating institutions, as well as outside consultants have participated in the development of this program. Their efforts which have provided source material for this guide have been acknowledged in the volumes to which they made major contributions. *Plant Operations for Wastewater Facilities* has been written and produced by:

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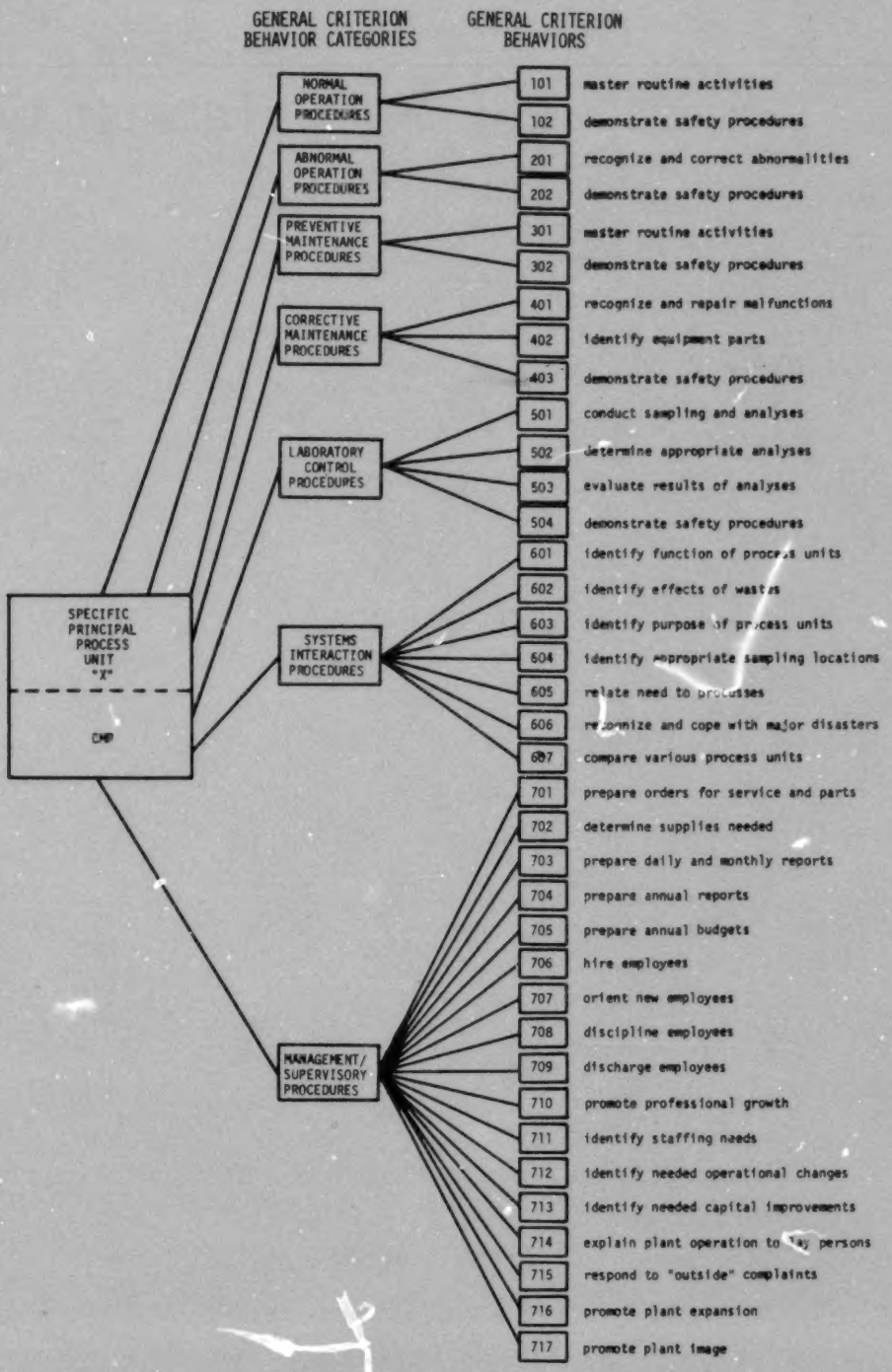
GENERAL CRITERION BEHAVIOR CATEGORIES
GENERAL CRITERION BEHAVIORS
NORMAL OPERATION PROCEDURES
ABNORMAL OPERATION PROCEDURES
PREVENTIVE MAINTENANCE PROCEDURES
CORRECTIVE MAINTENANCE PROCEDURES
LABORATORY CONTROL PROCEDURES
SYSTEMS INTERACTION PROCEDURES
MANAGEMENT/ SUPERVISORY PROCEDURES
SPECIFIC PRINCIPAL PROCESS UNIT "X"
CMP
101 master routine activities
102 demonstrate safety procedures
201 recognize and correct abnormalities
202 demonstrate safety procedures
301 master routine activities
302 demonstrate safety procedures
401 recognize and repair malfunctions
402 identify equipment parts
403 demonstrate safety procedures
501 conduct sampling and analyses
502 determine appropriate analyses
503 evaluate results of analyses
504 demonstrate safety procedures
601 identify function of process units
602 identify effects of wastes
603 identify purpose of process units
604 identify appropriate sampling locations
605 relate need to processes
606 recognize and cope with major disasters
607 compare various process units
701 prepare orders for service and parts
702 determine supplies needed
703 prepare daily and monthly reports
704 prepare annual reports
705 prepare annual budgets
706 hire employees
707 orient new employees
708 discipline employees
709 discharge employees
710 promote professional growth
711 identify staffing needs
712 identify needed operational changes
713 identify needed capital improvements
714 explain plant operation to lay persons
715 respond to "outside" complaints
716 promote plant expansion
717 promote plant image

Figure 1: Relationship of general criterion behaviors (performance objectives) to the general categories and composite model plant (CMP).

Performance Objectives

When the treatment plant operators, educators, consultants and representatives from professional water pollution control organizations came together to develop an effective instructional program, they recommended the use of performance or behavioral objectives because such objectives clearly outline:

1. What the student is expected to do as a result of the instructional program.
2. The conditions under which the student shall do it.
3. The standard of performance.

COMPOSITE MODEL PLANT

First, they developed a composite model plant (CMP) of twenty-two process units which is really many wastewater treatment plants in one model. Such a mix of process units seldom occurs in a treatment plant, but if a student becomes competent in the operation and management of the CMP he should be able to perform successfully in any treatment plant.

TASK ANALYSIS

Next, to ensure that the materials were specifically tailored to what the operator does on the job, a task analysis was conducted. They found that the tasks which an operator performs fell into seven general categories which were further divided into 37 tasks or general behaviors. (See figure 1, page vi.) The tasks were organized under:

1. Normal Operation Procedures. These include routine operating activities that do not vary significantly from day to day and that are designed to keep the plant functioning within a normal range of values. For example, the employee conducts routine samplings of the primary sludge and inspects pumping equipment and the wastestream to verify that the process is functioning properly.

2. Abnormal Operation Procedures. These include activities of the plant employee that result from unusual and undesirable conditions of the wastestream. The abnormal procedures enable the plant employee to recognize when the wastestream is abnormal and to return it to an acceptable, normal condition. An abnormal wastestream results when a normal operation procedure is not properly applied, a corrective maintenance procedure is needed or management/supervisory procedures are poor. For example, the plant employee should recognize that a black septic primary sludge sample is an abnormal condition of the wastestream and take appropriate action.

3. Preventive Maintenance Procedures. These include routine maintenance activities of the plant employee which prevent major equipment breakdown and subsequent corrective maintenance. For example, the employee would lubricate bearings and other moving parts, replace worn components and adjust components of the primary sludge pumps.

4. Corrective Maintenance Procedures. These include maintenance activities of the plant employee that usually result from the breakdown or malfunction of a unit of equipment or a component. For example, the employee would notice whether the primary sludge pump is malfunctioning and know when and how to correct the disorder or when and how to refer the problem to plant maintenance personnel.

5. Laboratory Control Procedures. These include special and routine activities relating to laboratory analysis, the specification of sampling procedures and locations and the general management of the laboratory facilities. For example, the employee would collect primary sludge samples and conduct the analyses.

6. Systems Interaction Procedures. These include activities of the plant employee which relate the functioning of specific units of equipment to other process units and to the system as a whole. For example, the employee would determine how the effective functioning of the primary sludge pumps relates to digester performance.

7. Management/Supervisory Procedures. These include activities relating to employment practices, record keeping, plant operation policy and the establishment of a constructive and realistic rapport between the plant and the community it serves. For example, the employee would keep records on primary sludge pumping, keep an inventory of spare parts and evaluate the adequacy of maintenance procedures by shift personnel.

CURRICULUM DESIGN

After deciding what process equipment an operator must operate and maintain, and finding out what an operator does through the task analysis, they listed the objectives a student must master to successfully operate a treatment plant. For example, the student will describe and perform the normal inspection procedure for the primary sedimentation unit including frequency of inspection, conditions to look for and the actions he should take.

INSTRUCTOR'S GUIDES

The next step was the design of manuals to guide the instructor. In the guides varied learning activities and imaginative innovations which produce more learning than traditional teaching methods are emphasized. The instructional suggestions do not need to be followed slavishly, but should be modified and improved as much as possible.

The instructor's goal is to achieve the objectives of the curriculum by selecting activities which suit the student's needs and help him to master all the information and skills in the course. The most effective learning occurs when the student is a participant in the learning process, not a spectator.

An instructor should use learning activities which approximate the situations which the student will meet *in the treatment plant.* If it is not possible to teach in a treatment plant, *simulated situations* should be set up in the workshop or classroom so that the student can solve rather than discuss problems. *Group discussion* stimulated by *visual materials* is an effective learning technique. Lecturing, however, is inefficient. Because the student is not actively involved during a lecture, the instructor should use lectures sparingly.

Introduction to Modules of Instruction

In this instructor's guide the topics and ideas are presented as a series of modules, organized around the general objectives stated in the course descriptions for Plant Operation I, II, III and IV and the In-Plant Practicum which are found in the *Program Implementation Procedures* of the *CEWT Program*. Each module is designed to help the instructor plan a course of study for the operation of a treatment process using the CMP process unit. Each module is organized around sixteen objectives common to all processes.

The modules in *Plant Operations for Wastewater Facilities* are arranged in the order in which the CMP process units occur in the treatment plant. Each process is identified by a letter of the alphabet and the process unit is described in the heading of the module. If the instructor uses the modules in consecutive order, he and his students will follow the treatment of the wastestream from collection to its discharge into the receiving waters. Each module is designed so it can be used as a minicourse in a treatment process. Instructors are urged to group the modules to suit their individual curriculum needs and instructional situations.

Material in the modules can easily be adapted for courses which upgrade the training of operators in normal operation procedures, abnormal operation procedures, preventive maintenance procedures or corrective maintenance procedures by grouping the appropriate objectives from all the modules. For example, an instructor could develop a course in corrective maintenance by grouping objectives 11 and 12 from each module.

INSTRUCTIONAL PROCESS UNITS

Each module assumes that the composite model plant unit will be used for instruction in the process. If the recommended unit is not available, an alternate process unit may be substituted and the instructional materials adapted. The recommended CMP units and alternate units for all the processes are listed in table 1, page 4. Two modules on sludge dewatering are included because it is impossible for a student to master operation of this process by learning to operate one process unit. Remember, however, that a student will be more adequately prepared to work in almost any treatment plant if he is trained on the CMP unit. When it is not possible to use the recommended unit, students should be informed about the operation and function of the unit and hands-on training should be conducted on the best alternate unit available.

PURPOSE OF THE MODULES

The modules in *Plant Operations for Wastewater Facilities* help the student to learn how to operate all the process units in the wastewater treatment plant. Normal operation, abnormal operation, preventive maintenance and corrective maintenance procedures are included. When the course is completed, he will know why each unit is

TABLE I

SPECIFIC PROCESS UNITS RECOMMENDED FOR USE IN IMPLEMENTATION OF THE TWO-YEAR POST HIGH SCHOOL WASTEWATER TECHNOLOGY INSTRUCTIONAL PROGRAM

Module	Process	CMP Unit	Recommended Teaching Unit	Alternate Teaching Unit
1	Collection	A	Combined system with industrial waste	Sanitary system with industrial waste
2	Chlorination	B	Vacuum chlorinator with automatic feed to pipe, pneumatic control and electric evaporator	Vacuum chlorinator with automatic feed to pipe, electrical control and electric evaporator
		N	Vacuum chlorinator with automatic feed to pipe and closed-loop pneumatic control	Vacuum chlorinator with automatic feed to pipe and closed electrical control
3	Screening and Grinding	C	Mechanically cleaned bubbler control unit with grinder	Mechanically cleaned electrode control unit with grinder
4	Grit Removal	D	Aerated unit with bucket elevator	Aerated unit with screw conveyor
5	Primary Sedimentation	E	Rectangular unit with telescopic valve drawoff, density meter time clock and trough with scraper	Circular unit with telescopic valve drawoff, density meter time clock and trough with scraper
6	Trickling Filtration	F	Rotary distributor, standard rate unit with dosing tank	Rotary distributor, high rate unit
7	Aeration	G	Diffused air unit with swing-type diffuser producing fine bubbles	Mechanical aeration unit with turbine and sparger
8	Secondary Sedimentation	H	Circular, peripheral-feed unit with suction	Circular, center-feed unit with suction
9	Pond Stabilization	I	Aerobic pond	Facultative pond
10	Thickening	J	Floatation unit with air	Floatation unit with vacuum
11	First Stage Digestion	K	Fixed cover, gas recirculation unit with external heat exchanger	Floating cover, gas recirculation unit with external heat exchanger

3112

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12	Second Stage Digestion	L	Floating cover unit with gas storage	Fixed cover unit
13	Sludge Conditioning	M	Chemical conditioning unit with counter-current elutriation	None
14a	Sludge Dewatering	O	Vacuum filter unit with cloth	Vacuum filter unit with coil
14b	Sludge Dewatering	O	Continuous feed centrifuge	None
15	Solids Disposal	P	Multiple hearth incinerator unit	Fluidized bed incinerator unit
16	Effluent Disposal	Q	Direct reuse system	Underground disposal system
17	Flow Measurement	R	Centralized recording and totalizing system including Parshall flume, Venturi meter, magnetic flowmeter and rotameter	None
18	Pumping and Piping	S	System with magnetically connected, pneumatically controlled, diesel driven, centrifugal pumps; speed reducer connected, electrically controlled, motor driven, positive displacement pumps and appropriate piping	None
19	Electric Power	T	System using delta transformers, generators, electrical switchgear, automatic gear, automatic circuit actuators on motors and telemetering with alarms.	System using Y transformers, generators, electrical switchgear, automatic circuit actuators on motors and telemetering with alarms
20	Gas Power	U	System with internally produced gas with high pressure tanks and rotary positive displacement compressors	System with internally produced gas with high pressure tanks and reciprocating compressors

important to the treatment plant and how it affects and interacts with other process units in the treatment system.

STUDENT PREREQUISITES

Completion of Introduction to Environmental Technology and courses in basic mathematics and biology qualify the student to enter the course in Unit Operations for Wastewater Facilities. Concurrent courses in basic chemistry and laboratory control are suggested. (See pages 7 to 19 of *Program Implementation Procedures*.)

TERMINAL OBJECTIVE

When the student has completed the modules of instruction in this course, he should be able to do the following for each of the processes in the treatment plant:

1. Identify the process unit.
2. Describe the process unit in technical and nontechnical terms.
3. Describe the safety procedures for the process unit and explain how the procedures protect employees and visitors.
4. Identify the components of the process unit. Explain the purpose of each component, how the component works and why it is important.
5. Describe the normal operation procedures for the process unit components.
6. Perform the normal operation procedures for the process unit.
7. Describe and perform the start-up and shut-down procedures for the process unit.
8. Describe the abnormal operation procedures for the process unit.
9. Describe the preventive maintenance procedures for the process unit.
10. Perform the preventive maintenance procedures for the process unit.
11. Describe the corrective maintenance procedures for the process unit components.
12. Perform the corrective maintenance procedures for the process unit components.
13. Perform the safety procedures for the process unit and demonstrate how they protect employees and visitors.
14. Compare other process units to the composite model plant unit.
15. Name and locate the components of the process unit. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.
16. Perform the abnormal operation procedures for the process unit.

RESOURCES

The listing of instructional resources suggests materials now available to instructors to accomplish the desired performance in the student.

Instructional materials 1 to 1866 are keyed to the reference, *Instructional Materials Available* which is available from:

Office of Water Program Operations
US Environmental Protection Agency
Washington, DC 20460

Two companion volumes to *Instructional Materials Available*, also available from EPA, offer suggestions for selecting audio-visual equipment:

Selecting Audio-Visual Equipment
Selecting Instructional Media and Instructional Systems

The following journals list addresses of companies from whom literature about the process units which they manufacture can be obtained:

"Environmental Science and Technology"
1155 Sixteenth Street, N.W.
Washington, DC 20036

"Water and Sewage Works"
434 South Wabash
Chicago, IL 60605

"Water and Wastes Engineering"
666 Fifth Avenue
New York, NY 10019

If suitable materials are not available, instructors are urged to develop their own resources.

FORMAT OF THE MODULES

The module begins with a statement of purpose which explains what the student will be studying. Next, all the objectives of the module and code numbers keyed to a computerized list of instructional resources are listed for the instructor's convenience.

Objectives. Each module includes sixteen objectives which bring the student to the performance level required by the terminal objective. The knowledge and skills demanded of the student become more complex as he progresses through the sixteen objectives in a module. He begins by identifying components and learning facts about the components and processes. He uses these facts to develop concepts and ideas. Finally, he relates the concepts and ideas to each other so that he can make decisions about plant procedures.

A glossary of verbs which follows this introduction defines the verbs used in the objectives so that the instructor is aware of what he is instructing the student to do and so that his evaluation of the student is based solely on what is stated in the objective.

Conditions. The conditions define the circumstances under which the student performs and is evaluated and lists the information, equipment and assistance to which the student will have access. The best available learning and testing conditions should be used. A process unit in a treatment plant or workshop has more impact on the students than photographs and drawings. For example, if the student is to be given a process unit, unit components, photographs or diagrams of a unit, the instructor should provide a process unit. If a process unit is not available, he would use components of the unit in combination with photographs of those components which he does not have available. Line drawings and diagrams should not be used if photographs and manufacturers' illustrations are available.

Acceptable Performance. The acceptable performance expands the objective and details the steps a student must follow to reach the objective. To move on to the next objective, at least 70% of each step or category must be mastered with no repeated errors between modules. For example, no student can complete the course of study if he consistently fails to give attention to moving parts as he

performs safety procedures or to describe the odor as he evaluates the characteristics of the wastestream. In this section the instructor will find the main topics of his lesson plan and for the evaluation of the student's performance.

Instructor Activity. The instructor should get to know his class by working with small groups and with each student. He should encourage students to learn from each other as they work together. He should involve the student in the instructional and learning process. Instructional activities are paired numerically with student activities.

Student Activity. This is a listing of activities which the student will take part in, in order to accomplish the specified performance.

EVALUATION TECHNIQUE

The instructor may use or adapt the learning activities listed under instructor activity and student activity as evaluation techniques. The technique chosen should reflect what the objective asks the student to do. For example, if a student is asked to *describe*, the evaluation technique is a *description*. The student should be evaluated under the conditions and to the performance level required for each objective.

Glossary of Verbs

The glossary of verbs is included here so that the instructor will know exactly what the student is being asked to do to meet his objective. Notice the difference, for example, between the meanings of *identify* and *name*. When a student is asked to identify, the instructor is providing the name of the thing to be identified. But, when the student must name something, he must supply the name.

The list includes all the verbs from the objectives and the acceptable performance sections of all the modules, as well as some verbs used in the instructor and student activities.

	DEFINITION	APPLICATION
APPLY	To make use of as suitable, fitting or relevant.	Apply the preventive maintenance schedule for the second stage digestion unit.
CHECK	To inspect and ascertain the condition of, especially in order to determine that the condition is satisfactory.	Check the characteristics of each component.
COMMENT ON	To express an opinion or attitude about what has been seen or heard.	Comment on employee safety procedures.
COMPARE	To examine the character or qualities of, especially for the purpose of discovering resemblances or differences.	Compare other aeration units to the diffused air unit with swing-type diffuser producing fine bubbles.
CONSIDER	To give thought to with a view to purchasing, accepting or adopting.	Consider availability of replacement parts, capital costs, ease of repair, efficiency, maintenance costs, and so forth.
CORRECT	To alter or adjust to bring to some standard or required condition.	Correct the malfunction.
DEMONSTRATE	To illustrate or explain in an orderly and detailed way with many examples, specimens and particulars.	Demonstrate the start-up procedures in a treatment plant.

	DEFINITION	APPLICATION
DESCRIBE	To represent by words written or spoken for the knowledge or understanding of others, to transmit an image of the identifying features, the nature and characteristics of objects, events and actions.	Describe the safety procedures for the screening and grinding unit.
DEVELOP	To produce or generate.	Develop a picture file of first stage digestion units.
DISCUSS	To talk about, to present in detail, to exchange views or information about.	Discuss treatment plant case histories.
EVALUATE	To examine and make a judgement about quality, significance, amount, degree or condition of.	Evaluate the wastestream for abnormal conditions.
EXPLAIN	To make plain or clear, to present in detail.	Explain the purpose of each component, how the component works and why it is important.
IDENTIFY	To establish the identity of, pick out or single out an object in response to its name by pointing, picking up, underlining, marking or other responses.	Identify the components of the chlorination unit.
INDICATE	To state or express without going into detail.	Indicate whether the process unit is used for secondary sedimentation.
INSPECT	To view closely and critically, to determine quality or state, to detect errors or otherwise appraise.	Inspect a treatment plant.
LIST	To enumerate or specify.	List routine calculations for the pond stabilization unit.
LOCATE	To stipulate the position of an object in relation to other objects.	Locate the components of the trickling filtration unit.

	DEFINITION	APPLICATION
NAME	To supply the correct name, in oral or written form, for an object, class of objects, persons, places, conditions or events which are pointed out or described.	Name the components of the primary sedimentation unit.
OBSERVE	To pay careful, directed, analytical attention to.	Observe the thickening process during a plant tour.
PERFORM	To carry out an action or pattern of behavior. (Implies an act for which a process or pattern of movement has already been established, especially one calling for skill or precision, or for the assignment or assumption of responsibility.)	Perform the normal operation procedures for the grit removal unit.
POINT OUT	To indicate the position or direction of, especially by extending a finger toward the thing so indicated, to direct someone's attention to.	Point out characteristics which distinguish the first stage digestion unit from other units.
RECOMMEND	To mention or introduce as being worthy of acceptance, use or trial, to advise.	Recommend procedures to correct the unsafe conditions.
SELECT	To choose something from a number or group usually by fitness, excellence, or other distinguishing feature.	Select the reference materials and tools needed to perform the corrective maintenance.

MODULE 1

COLLECTION

A combined system with industrial waste

Composite Model Plant Unit A

PURPOSE: *In this module the student will learn to perform all the activities in the objectives as they apply to a combined system with industrial waste. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

OBJECTIVES:

1.1 *Identify the collection system.*

1.2 *Describe the collection system in technical and nontechnical terms.*

1.3 *Describe the safety procedures for the collection system and explain how the procedures protect employees and visitors.*

1.4 *Identify the components of the collection system. Explain the purpose of each component, how the component works and why it is important.*

1.5 *Describe the normal operation procedures for the collection system components listed on page 17.*

1.6 *Perform the normal operation procedures for the collection system.*

1.7 *Describe and perform the start-up and shut-down procedures for the collection system.*

1.8 *Describe the abnormal operation procedures for the collection system.*

1.9 *Describe the preventive maintenance procedures for the collection system.*

1.10 *Perform the preventive maintenance procedures for the collection system.*

1.11 *Describe the corrective maintenance procedures for the collection system components listed on page 17.*

1.12 *Perform the corrective maintenance procedures for the collection system components.*

1.13 *Perform the safety procedures for the collection system and demonstrate how they protect employees and visitors.*

1.14 *Compare other collection systems to the combined system with industrial waste (composite model plant unit A).*

1.15 *Name and locate the components of the collection system listed on page 17. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

1.16 Perform the abnormal operation procedures for the collection system.

RESOURCES: 3 116 120 121 125 141 143 144 307 308 309 316 317 320 321 324 421 459 511 551 552 553 554 937 990 1033 1034 1318 1399

<<<<<<>>>>>>

OBJECTIVE 1.1: *Identify the collection system.*

CONDITIONS: Given a system, model of a system or a photograph of a system.

ACCEPTABLE PERFORMANCE: The student will:

Indicate whether the system is used for collection.

INSTRUCTOR ACTIVITY:

1. Point out characteristics which identify the collection system.

STUDENT ACTIVITY:

1. Develop a picture file of collection systems. Mark distinguishing characteristics.

<<<<<<>>>>>>

OBJECTIVE 1.2: *Describe the collection system in technical and nontechnical terms.*

CONDITIONS: Given photographs of the collection system.

ACCEPTABLE PERFORMANCE: The student will:

Describe the collection system, explaining the meaning of:
- collection system
- force main system
- gravity flow system
- sewer
- sewer system
- sewerage

Describe the purpose of collection.

Describe how the kind of collection system affects:
- primary sedimentation
- pond stabilization
- pumping and piping

INSTRUCTOR ACTIVITY:

1. Use diagrams, photographs and slides to describe the collection system.
2. Describe the collection system during a tour of the system. React to the student's description of the system.

STUDENT ACTIVITY:

1. Describe the collection system while viewing photographs, diagrams and slides.
2. Observe and describe the collection system during a tour of the system.

<<<<<<>>>>>>

OBJECTIVE 1.3: *Describe the safety procedures for the collection system and explain how the procedures protect employees and visitors.*

CONDITIONS: Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE: The student will:

Describe the safety procedures for the collection system, commenting on:
- High-risk activities
  - entering or leaving manholes
  - working alone
  - working in excavations
- Sources of danger
  - cave-ins
  - electricity
  - explosive solvents
  - flooding
  - heavy construction equipment
  - infection
  - ladders
  - manhole covers
  - open channels or pits
  - oxygen deficiency

Sources of danger (continued)
- rotating and reciprocating equipment
- toxic gases
- traffic

Safety equipment
- blower
- dewatering equipment
- exhaust fans
- explosion proof lights
- explosive gas detector
- first-aid kit
- flashing lights
- harness
- oxygen deficiency meter
- protective clothing
- rope
- self-contained breathing apparatus
- shoring equipment
- traffic barriers
- traffic cones

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss collection system case histories.
2. Describe the conditions in a collection system and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the collection system.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<<>>>>>>

OBJECTIVE 1.4: *Identify the components of the collection system. Explain the purpose of each component, how the component works and why it is important.*

CONDITIONS: Given a collection system, system components or a diagram, model or photographs of a system and a list of components.

ACCEPTABLE PERFORMANCE: The student will:

Identify components of the collection system and associated equipment:

- catch basin
- dosing tank
- fire-fighting equipment
- first-aid kit
- flap gate
- house connection
- inverted siphon
- manhole
- manhole cover
- outfall
- pipe
- pipe joint
- pump station
- regulator
- screen
- sewer tap
- sewers
  - branch
  - collector
  - interceptor
  - lateral
  - main
  - trunk
- tap line
- weir

Explain the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a tour of the system.
4. Question the students about the purpose of each component, how the component works and why it is important.

STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a tour of the system.
4. Explain the purpose of each component, how the component works and why it is important.

<<<<<<<<<<

OBJECTIVE 1.5: *Describe the normal operation procedures for the collection system components listed on page 17.*

CONDITIONS: Given a collection system or slides or photographs of a collection system, a list of components of the system, a checklist of characteristics and a normal operation procedures manual.

ACCEPTABLE PERFORMANCE: The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

- corrosion
- erosion
- exfiltration
- flow
- infiltration
- position
- pressure
- slope
- velocity

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:

- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the collection system.

List routine calculations for the collection system.

Describe routine procedures for recording data.

INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the collection system.
2. Describe the normal operation procedures for the collection system. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the collection system.

4. Describe and explain the normal operation procedures during a tour of the system. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the collection system and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the collection system.
4. Observe and describe the normal operation procedures during a tour of the system.

<<<<<<>>>>>>

OBJECTIVE 1.6: *Perform the normal operation procedures for the collection system.*

CONDITIONS: Given a collection system, the manual of normal operation procedures which the student has developed for the collection system and basic references.

ACCEPTABLE PERFORMANCE: The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run on a collection system.
2. Observe the student performing normal operation procedures on a collection system.

STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run on a collection system.
2. Perform and explain the normal operation procedures on a collection system.

<<<<<<>>>>>>

OBJECTIVE 1.7: *Describe and perform the start-up and shut-down procedures for the collection system.*

CONDITIONS: Given a mock-up, model or photograph of a collection system.

ACCEPTABLE PERFORMANCE: The student will:

Start up and shut down the components of a collection system, following the manufacturer's instructions.

INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures.
2. Demonstrate and perform the shut-down procedures.
3. Observe the student performing the start-up procedures.
4. Observe the student performing the shut-down procedures.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run.
2. Describe the shut-down procedures in a dry run.
3. Perform the start-up procedures.
4. Perform the shut-down procedures.
5. Evaluate the operation of the collection system to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the collection system to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

<<<<<<>>>>>>

OBJECTIVE 1.8: *Describe the abnormal operation procedures for the collection system.*

CONDITIONS:

Given a wastestream in a collection system or color photographs of a wastestream, a checklist of the conditions of the wastestream and system records and reference materials.

ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

acidity	level
color	odor
DO	oil
floating material	pH
flow	septic sewage
foam	settleable matter
grease	temperature
industrial wastes	toxic gases
ice	velocity

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:

- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in system records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a tour of the system. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.

2. Describe and explain the abnormal operation procedures illustrated in pictures and described in system records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a tour of the system. Describe and explain the abnormal operation procedures.

<<<<<<>>>>>>

OBJECTIVE 1.9: *Describe the preventive maintenance procedures for the collection system.*

CONDITIONS: Given a collection system or pictures and drawings of a collection system and reference materials, including:
- inspection records
- manufacturer's maintenance guides
- preventive maintenance schedule
- system drawings and specifications

ACCEPTABLE PERFORMANCE: The student will:

Describe these preventive maintenance procedures for the collection system:

- Cleaning
  - catch basin
  - dosing tank
  - flap gate
  - house connection
  - inverted siphon
  - manhole
  - outfall
  - pipe
  - pipe joint
  - pump station
  - regulator
  - screen
  - sewer tap
  - sewers
    - branch
    - collector
    - interceptor
    - lateral
    - main
    - trunk
  - tap line
  - weir
- Inspection
  - manhole
- Lubrication
  - flap gate
  - pump station
  - regulator
- Mechanical adjustment
  - flap gate
  - pump station
  - regulator
  - weir
- Painting
  - flap gate
  - manhole
  - pump station
  - regulator
  - weir
- Replacement
  - fire-fighting equipment

Replacement (continued)
- first-aid kit
- flap gate
- manhole cover
- pump station
- regulator
- screen
- weir

Wear measurement
- manhole
- sewer

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the collection system.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a tour of the system.

STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a tour of the system.

<<<<<<>>>>>>

OBJECTIVE 1.10: *Perform the preventive maintenance procedures for the collection system.*

CONDITIONS: Given a collection system and tools and reference materials, including:
- inspection records
- manufacturer's maintenance guides

preventive maintenance schedule
system drawings and specifications

ACCEPTABLE PERFORMANCE: The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the collection system, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a collection system.
3. Observe the student performing the preventive maintenance procedures on a collection system.

STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a collection system. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures on a collection system.

<<<<<<>>>>>>

OBJECTIVE 1.11: *Describe the corrective maintenance procedures for the collection system components listed on page 17.*

CONDITIONS: Given a collection system or a mock-up, photographs or drawings of a collection system, the manual of operation procedures which the student has developed for the collection system, tools and reference materials, including:

catalogue of replacement parts
equipment catalogues
manufacturer's maintenance guides

ACCEPTABLE PERFORMANCE: The student will:

Describe how an operator evaluates each component of the collection system for corrective maintenance, commenting on:

corrosion	position
erosion	pressure
exfiltration	slope
flow	velocity
infiltration	

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the collection system, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during tours of the system.

STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a tour of the system.

<<<<<<>>>>>>

OBJECTIVE 1.12: *Perform the corrective maintenance procedures for the collection system components.*

CONDITIONS:

Given a collection system or system components, the operation procedures manual which the student has developed, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the components of the collection system for corrective maintenance, explaining why a component has malfunctioned and commenting on:

- corrosion
- erosion
- exfiltration
- flow
- infiltration
- position
- pressure
- slope
- velocity

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates a collection system.
3. Observe the student performing the corrective maintenance procedures on a collection system.

STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures on a collection system.

<<<<<<>>>>>>

OBJECTIVE 1.13: *Perform the safety procedures for the collection system and demonstrate how they protect employees and visitors.*

CONDITIONS: Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE: The student will:

Identify hazardous conditions in the collection system, commenting on:
- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a collection system.
3. Observe the student performing the safety procedures on a collection system.

STUDENT ACTIVITY:

1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a collection system and recommend corrective procedures.
3. Perform the safety procedures on a collection system.

<<<<<<>>>>>>

OBJECTIVE 1.14 *Compare other collection systems to the combined system with industrial waste (composite model plant unit A).*

CONDITIONS: Given a process unit and reference materials, including:
- equipment catalogues
- laboratory reports
- manufacturer's bulletins
- manufacturer's operation manuals
- system maintenance and operation records

ACCEPTABLE PERFORMANCE: The student will:

Compare composite model plant unit A with:
- a sanitary system with industrial waste.
- a combined system without industrial waste.
- a sanitary system without industrial waste.

Consider:
- availability of replacement parts
- capital costs
- dependency on surrounding environment
- ease of repair
- efficiency
- flow-handling capabilities
- maintenance costs
- nuisance to neighbors
- operational costs
- operational skills
- personnel requirements
- reliability
- resistance to upset
- sensitivity of controls
- space requirements
- waste-handling capabilities

INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the systems.
2. Compare composite model plant unit A with the other systems.
3. Help the student to collect information for reports on the advantages and disadvantages of each system.

STUDENT ACTIVITY:

1. List information about the systems on a chart.
2. Compare the systems in a panel discussion.
3. Write a report on the advantages and disadvantages of each system.

<<<<<<>>>>>>

OBJECTIVE 1.15: *Name and locate the components of the collection system listed on page 17. Name and select the reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

CONDITIONS: Given a collection system, system components or a diagram, model or photographs of a system and reference materials, including:
- contractor's plans of the collection system
- manufacturer's maintenance guides
- operation and maintenance manuals

ACCEPTABLE PERFORMANCE: The student will:

Name and locate the components of the collection system.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:
1. Point out components of the collection system on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a tour of the system.
3. Name and display the reference materials which describe the collection system and normal operation procedures.

STUDENT ACTIVITY:
1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a tour of the system and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the collection system and normal operation procedures.

<<<<<<>>>>>>

OBJECTIVE 1.16: *Perform the abnormal operation procedures for the collection system.*

CONDITIONS: Given a wastestream in a collection system and reference materials, including:
- industrial waste records
- operation logs

operator manuals
system performance guides

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

acidity	level
color	odor
DO	oil
floating material	pH
flow	septic sewage
foam	settleable matter
grease	temperature
industrial wastes	toxic gases
ice	velocity

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in the collection system.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in the collection system.

STUDENT ACTIVITY:

1. Evaluate the wastestream in the collection system.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in the collection system.

<<<<<<>>>>>>

MODULE 2

CHLORINATION

A vacuum chlorinator with automatic feed to pipe, pneumatic control and electrical evaporator or a vacuum chlorinator with automatic feed to pipe and closed-loop pneumatic control

Composite Model Plant Units B and N

PURPOSE: *In this module the student will learn to perform all the activities in the objectives as they apply to a vacuum chlorinator with automatic feed to pipe, pneumatic control and electrical evaporator or to a vacuum chlorinator with automatic feed to pipe and closed-loop pneumatic control. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

OBJECTIVES:

2.1 *Identify the chlorination unit.*

2.2 *Describe the chlorination process in technical and nontechnical terms.*

2.3 *Describe the safety procedures for the chlorination unit and explain how the procedures protect employees and visitors.*

2.4 *Identify the components of a chlorination unit. Explain the purpose of each component, how the component works and why it is important.*

2.5 *Describe the normal operation procedures for the chlorination unit components listed on page 35.*

2.6 *Perform the normal operation procedures for the chlorination unit.*

2.7 *Describe and perform the start-up and shut-down procedures for the chlorination unit.*

2.8 *Describe the abnormal operation procedures for the chlorination process.*

2.9 *Describe the preventive maintenance procedures for the chlorination unit.*

2.10 *Perform the preventive maintenance procedures for the chlorination unit.*

2.11 *Describe the corrective maintenance procedures for the chlorination unit components listed on page 35.*

2.12 *Perform the corrective maintenance procedures for the chlorination unit components.*

2.13 *Perform the safety procedures for the chlorination unit and demonstrate how they protect employees and visitors.*

2.14 *Compare other chlorination units to the vacuum chlorinator with automatic feed to pipe, pneumatic control and electric*

evaporator (composite model plant unit B) and the vacuum chlorinator with automatic feed to pipe and closed-loop pneumatic control (composite model plant unit N).

2.15 *Name and locate the components of the chlorination unit listed on page 35. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

2.16 *Perform the abnormal operation procedures for the chlorination unit.*

RESOURCES: 3 116 120 125 141 143 144 307 308 309 316 317 320 321 324 421 459 472 489 511 543 551 552 553 554 700 702 851 937 966 967 968 969 970 972 974 975 976 977 978 979 980 984 985 990 1033 1034 1399 1408

<<<<<<>>>>>>

OBJECTIVE 2.1 *Identify the chlorination unit.*

CONDITIONS: Given a unit, a model of a unit or a photograph of a unit.

ACCEPTABLE PERFORMANCE: The student will:

Indicate whether the process unit is used for chlorination.

INSTRUCTOR ACTIVITY:

1. Point out characteristics which distinguish the chlorination unit from other process units.

STUDENT ACTIVITY:

1. Develop a picture file of chlorination units. Mark distinguishing characteristics.

<<<<<<>>>>>>

OBJECTIVE 2.2: *Describe the chlorination process in technical and non-technical terms.*

CONDITIONS: Given a list of chlorine application points and a diagram of application points.

ACCEPTABLE PERFORMANCE: The student will:

Describe the chlorination unit, explaining the meaning of:
- chlorine
- chlorine contact chamber
- chlorine system
- closed-loop residual control

Point out the application points for:
- upsewer chlorination
- prechlorination
- plant chlorination
- post-chlorination

Describe the purpose of chlorination at each location.

Describe how chlorination affects:
- collection system
- prechlorination
- primary sedimentation
- trickling filtration
- aeration
- pond stabilization
- effluent disposal
- pumping and piping

INSTRUCTOR ACTIVITY:

1. Use diagrams, photographs and slides to illustrate chlorination application points.
2. Point out application points and the effects of chlorination at the application points during a plant tour.

STUDENT ACTIVITY:

1. Point out and describe chlorine application points on plant diagrams.
2. Observe and describe the application points and the effects of chlorination at the application points during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 2.3: *Describe the safety procedures for the chlorination unit and explain how the procedures protect employees and visitors.*

CONDITIONS: Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE: The student will:

Describe the safety procedures for the chlorination unit, commenting on:

- High-risk activities
  - changing cylinders
  - removing debris from channels
  - replacing valves and pigtails
  - working alone
- Sources of danger
  - acid wastes
  - automatic switches
  - caustic wastes
  - electrical equipment
  - explosive gases
  - hot pipes
  - moving parts
  - open channels and pits
  - open doors and covers
  - slippery walks or stairs
  - tools
  - toxic gases
- Safety equipment
  - chlorine leak detector
  - deluge shower
  - emergency repair kit
  - eyewash
  - fire extinguisher
  - first-aid kit
  - gas mask
  - lockout tags and keys
  - protective clothing
  - railings
  - rope
  - self-contained breathing apparatus
  - stair treads
  - ventilation system

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the chlorination unit.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<<>>>>>>

OBJECTIVE 2.4:

Identify the components of a chlorination unit. Explain the purpose of each component, how the component works and why it is important.

CONDITIONS:

Given a chlorination unit, unit components or a diagram, model or photographs of a unit and a list of components.

ACCEPTABLE PERFORMANCE:

The student will:

Identify components of the chlorination unit and associated equipment:

- air-storage tank
- alarms
  - chlorine pressure
  - evaporator level
  - leak detector
- analyzer
- chart drive
- compressor
- container
- cylinder
- drive belt
- evaporator
- fire-fighting equipment
- first-aid kit
- gas mask
- hoist
- motor
- pen
- pigtail
  - adapter
  - cap
  - flex line
  - yoke
- pneumatic control
- recording chart
- regulators
  - chlorine pressure
  - injector vacuum
  - water pressure
- rotameter float
- rupture disc
- scale
- valves
  - cylinder
  - header
  - pressure reducing
- vent fan

Explain the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.

STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

<<<<<<>>>>>>

OBJECTIVE 2.5: *Describe the normal operation procedures for the chlorination unit components listed on page 35.*

CONDITIONS: Given a chlorination unit or slides or photographs of a chlorination unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

ACCEPTABLE PERFORMANCE: The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

color	pressure
corrosion	sound
flow	temperature
motion	vacuum
odor	vibration
position	

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:
- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the chlorination process.

List routine calculations for the chlorination process.

Describe routine procedures for recording data.

INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the chlorination unit.
2. Describe the normal operation procedures for the chlorination unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the chlorination unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the chlorination unit and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the chlorination unit.
4. Observe and describe the normal operation procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 2.6: *Perform the normal operation procedures for the chlorination unit.*

CONDITIONS: Given a chlorination unit, the manual of normal operation procedures which the student has developed for the chlorination unit and basic references.

ACCEPTABLE PERFORMANCE: The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 2.7: *Describe and perform the start-up and shut-down procedures for the chlorination unit.*

CONDITIONS: Given a mock-up, model or photograph of a chlorination unit and a chlorination unit with the manufacturer's operation manual.

ACCEPTABLE PERFORMANCE: The student will:

Start up and shut down a chlorination unit, following the manufacturer's instructions.

INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down

procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the chlorination unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the chlorination unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

<<<<<<>>>>>>

OBJECTIVE 2.8: *Describe the abnormal operation procedures for the chlorination process.*

CONDITIONS: Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

BOD	flow
chlorine demand	industrial wastes
chlorine residual	odor
COD	pH
coliform	septic sewage
composition	toxic gases

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:
- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

<<<<<<>>>>>>

OBJECTIVE 2.9: *Describe the preventive maintenance procedures for the chlorination unit.*

CONDITIONS: Given a chlorination unit or pictures and drawings of a chlorination unit and reference materials, including:
- inspection records
- manufacturer's maintenance guides

plant drawings and specifications
preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Describe these preventive maintenance procedures for the chlorination unit:

- Cleaning
  - pen
  - valve
- Lubrication
  - compressor
  - hoist
  - motor
- Mechanical adjustment
  - air-storage tank
  - alarms
    - chlorine pressure
    - evaporator level
    - leak detector
  - analyzer
  - chart drive
  - compressor
  - container
  - drive belt
  - evaporator
  - gas mask
  - hoist
  - motor
  - pneumatic control
  - regulators
    - chlorine pressure
    - injector vacuum
    - water pressure
  - rupture disc
  - scale
  - valves
    - cylinder
    - header
    - pressure reducing
  - vent fan
- Painting
  - air-storage tank
  - compressor
  - motor
- Replacement
  - alarms
    - chlorine pressure
    - evaporator level
    - leak detector
  - analyzer
  - chart drive
  - compressor
  - container
  - cylinder
  - drive belt
  - evaporator
  - fire-fighting equipment
  - first-aid kit
  - gas mask
  - hoist
  - motor
  - pen
  - pigtail
    - adapter
    - cap
    - flex line
    - yoke
  - pneumatic control
  - recording chart
  - regulators
    - chlorine pressure
    - injector vacuum
    - water pressure
  - rotameter float
  - rupture disc
  - scale
  - valves
    - cylinder
    - header
    - pressure reducing
  - vent fan
- Wear measurement
  - scale
  - valve

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the chlorination unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 2.10: *Perform the preventive maintenance procedures for the chlorination unit.*

CONDITIONS: Given a chlorination unit and tools and reference materials, including:

inspection records
manufacturer's maintenance guides
plant drawings and specifications
preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the chlorination unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 2.11: *Describe the corrective maintenance procedures for the chlorination unit components listed on page 35.*

CONDITIONS: Given a chlorination unit or a mock-up, photographs or drawings of a chlorination unit, the manual of operation procedures which the student has developed for the chlorination unit, tools and reference materials, including:

catalogue of replacement parts
equipment catalogues
manufacturer's maintenance guides

ACCEPTABLE PERFORMANCE: The student will:

Describe how an operator evaluates each component of the chlorination unit for corrective maintenance, commenting on:

color	pressure
corrosion	sound
flow	temperature
motion	vacuum
odor	vibration
position	

Explain when a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the chlorination unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

<<<<<<>>>>>>

OBJECTIVE 2.12: *Perform the corrective maintenance procedures for the chlorination unit components.*

CONDITIONS: Given a chlorination unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:
- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the components of the chlorination unit for corrective maintenance, explaining why a component

has malfunctioned and commenting on:

color	pressure
corrosion	sound
flow	temperature
motion	vacuum
odor	vibration
position	

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

<<<<<<>>>>>>

OBJECTIVE 2.13: *Perform the safety procedures for the chlorination unit and demonstrate how they protect employees and visitors.*

CONDITIONS: Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE: The student will:

Identify hazardous conditions in the chlorination unit, commenting on:
- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

<<<<<<<>>>>>>>

OBJECTIVE 2.14: *Compare other chlorination units to the vacuum chlorinator with automatic feed to pipe, pneumatic control and electric evaporator (composite model plant unit B) and the vacuum chlorinator with automatic feed to pipe and closed-loop pneumatic control (composite model plant unit N).*

CONDITIONS: Given a process unit and reference materials, including:
- equipment catalogues
- laboratory reports
- manufacturer's bulletins
- manufacturer's operation manuals
- plant maintenance and operation records

ACCEPTABLE PERFORMANCE: The student will:

Compare composite model plant unit B with:
- a vacuum chlorinator with automatic feed to pipe,

electrical control and electrical evaporator.
a solution feed chlorinator with discharge to pipe.
a solution feed chlorinator with discharge to channel.
a solution feed chlorinator with discharge to basin.
a vacuum chlorinator with electrical evaporator and discharge to channel.
a vacuum chlorinator with electrical evaporator and discharge to basin.
a chlorinator with manual control.

Consider:
availability of replacement parts
capital costs
dependency on surrounding environment
ease of repair
efficiency
flow-handling capabilities
maintenance costs
nuisance to neighbors
operational costs
operational skills
personnel requirements
reliability
resistance to upset
sensitivity of controls
space requirements
waste-handling capabilities

INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant units B and N with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

STUDENT ACTIVITY:

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

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OBJECTIVE 2.15: *Name and locate the components of the chlorination unit listed on page 35. Name and select reference materials*

which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

CONDITIONS:

Given a chlorination unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

contractor's plans of the chlorination unit
manufacturer's maintenance guides
operation and maintenance manuals

ACCEPTABLE PERFORMANCE:

The student will:

Name and locate the components of the chlorination unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out components of the chlorination unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the chlorination unit and normal operation procedures.

STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the chlorination unit and normal operation procedures.

<<<<<<<<<<<

OBJECTIVE 2.16:

Perform the abnormal operation procedures for the chlorination unit.

CONDITIONS: Given a wastestream in a treatment plant and reference materials, including:

- industrial waste records
- operation logs
- operator manuals
- plant performance guides

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

BOD	flow
chlorine demand	industrial wastes
chlorine residual	odor
COD	pH
coliform	septic sewage
composition	toxic gases

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

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MODULE 3

SCREENING AND GRINDING

A mechanically cleaned bubbler unit with grinder

Composite Model Plant Unit C

PURPOSE: *In this module the student will learn to perform all the activities in the objectives as they apply to a mechanically cleaned bubbler unit with grinder. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

OBJECTIVES:

3.1 *Identify the screening and grinding unit.*

3.2 *Describe the screening and grinding process in technical and nontechnical terms.*

3.3 *Describe the safety procedures for the screening and grinding unit and explain how the procedures protect employees and visitors.*

3.4 *Identify the components of a screening and grinding unit. Explain the purpose of each component, how the component works and why it is important.*

3.5 *Describe the normal operation procedures for the screening and grinding unit components listed on page 55.*

3.6 *Perform the normal operation procedures for the screening and grinding unit.*

3.7 *Describe and perform the start-up and shut-down procedures for the screening and grinding unit.*

3.8 *Describe the abnormal operation procedures for the screening and grinding process.*

3.9 *Describe the preventive maintenance procedures for the screening and grinding unit.*

3.10 *Perform the preventive maintenance procedures for the screening and grinding unit.*

3.11 *Describe the corrective maintenance procedures for the screening and grinding unit components listed on page 55.*

3.12 *Perform the corrective maintenance procedures for the screening and grinding unit components.*

3.13 *Perform the safety procedures for the screening and grinding unit and demonstrate how they protect employees and visitors.*

3.14 *Compare other screening and grinding units to the mechanically cleaned bubbler unit with grinder (composite model plant unit C).*

3.15 *Name and locate the components of the screening and grinding unit listed on page 55. Name and select reference materials which explain the normal operation procedures, the purpose of*

each component, how the component works and why it is important.

3.16 Perform the abnormal operation procedures for the screening and grinding unit.

RESOURCES: 3 116 120 125 141 143 144 307 308 309 316 317 320 321 324 421 459 511 551 552 553 554 937 990 1033 1034 1399

<<<<<<>>>>>>

OBJECTIVE 3.1: *Identify the screening and grinding unit.*

CONDITIONS: Given a unit, model of a unit or a photograph of a unit.

ACCEPTABLE PERFORMANCE: The student will:

Indicate whether the process unit is used for screening and grinding.

INSTRUCTOR ACTIVITY:

1. Point out characteristics which distinguish the screening and grinding unit from other process units.

STUDENT ACTIVITY:

1. Develop a picture file of screening and grinding units. Mark distinguishing characteristics.

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OBJECTIVE 3.2: *Describe the screening and grinding process in technical and nontechnical terms.*

CONDITIONS: Given photographs of the screening and grinding unit.

ACCEPTABLE PERFORMANCE: The student will:

Describe the screening and grinding unit.

Describe the purpose of screening and grinding.

Describe how screening and grinding affects:
grit removal
primary sedimentation

trickling filtration
aeration
pond stabilization
first stage digestion
solids disposal
effluent disposal
pumping and piping

INSTRUCTOR ACTIVITY:

1. Use diagrams, photographs and slides to describe screening and grinding.
2. Describe the screening and grinding process during a plant tour. React to the student's description of the process.

STUDENT ACTIVITY:

1. Describe the screening and grinding process while viewing photographs, diagrams and slides.
2. Observe and describe the screening and grinding process during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 3.3:

Describe the safety procedures for the screening and grinding unit and explain how the procedures protect employees and visitors.

CONDITIONS:

Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE:

The student will:

Describe the safety procedures for the screening and grinding unit, commenting on:

- High-risk activities
  - entering deep wells
  - hoisting gates
  - making adjustments with switch in automatic position
  - replacing shear pins
  - retrieving debris from channels
- Sources of danger
  - acid wastes
  - caustic wastes
  - electrical equipment
  - explosive gases
  - moving parts

Sources of danger (continued)
- open doors or covers
- slippery gratings
- slippery walks
- toxic gases
- welding torch

Safety equipment
- first-aid kit
- harness
- lockout tags and keys
- oxygen deficiency meter
- protective clothing
- railings
- rope
- stair treads
- ventilation system

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the screening and grinding unit.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<<>>>>>>

OBJECTIVE 3.4: *Identify the components of a screening and grinding unit. Explain the purpose of each component, how the component works and why it is important.*

CONDITIONS: Given a screening and grinding unit, unit components or a diagram, model or photographs of a unit and a list of components.

ACCEPTABLE PERFORMANCE: The student will:

Identify components of the screening and grinding unit and associated equipment:

- alarm
- bar-screen enclosure
- bar rack
- belt drive
- chain
- channel inlet gate
- channel outlet gate
- control section
- drain system
- fire-fighting equipment
- first-aid kit
- flushing valve
- flushing water system
- grinder
- limit switch
- motor
- rake
- rake-cleaner
- rake drive
- screen belt
- shaft
- speed reducer
- sprocket

Explain the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.

STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

<<<<<<>>>>>>

OBJECTIVE 3.5: *Describe the normal operation procedures for the screening and grinding unit components listed above.*

CONDITIONS:

Given a screening and grinding unit or slides or photographs of a screening and grinding unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

ACCEPTABLE PERFORMANCE:

The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

- capacity
- color
- corrosion
- depth
- deterioration
- flow
- motion
- odor
- position
- sound
- temperature
- vibration

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:

- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the screening and grinding process.

List routine calculations for the screening and grinding process.

Describe routine procedures for recording data.

INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the screening and grinding unit.
2. Describe the normal operation procedures for the screening and grinding unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the screening and grinding unit.

4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the screening and grinding unit and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the screening and grinding unit.
4. Observe and describe the normal operation procedures during a plant tour.

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OBJECTIVE 3.6: *Perform the normal operation procedures for the screening and grinding unit.*

CONDITIONS: Given a screening and grinding unit, the manual of normal operation procedures which the student has developed for the screening and grinding unit and basic references.

ACCEPTABLE PERFORMANCE: The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.

2. Perform and explain the normal operation procedures in a treatment plant.

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OBJECTIVE 3.7: *Describe and perform the start-up and shut-down procedures for the screening and grinding unit.*

CONDITIONS: Given a mock-up, model or photograph of a screening and grinding unit and a screening and grinding unit with a manufacturer's operation manual.

ACCEPTABLE PERFORMANCE: The student will:

Start up and shut down a screening and grinding unit, following the manufacturer's instructions.

INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the screening and grinding unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the screening and grinding unit to determine whether correct shut-down

procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

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OBJECTIVE 3.8: *Describe the abnormal operation procedures for the screening and grinding process.*

CONDITIONS: Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

- floating material
- flow
- industrial wastes
- level
- toxic gases

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:

- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.
4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

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OBJECTIVE 3.9: *Describe the preventive maintenance procedures for the screening and grinding unit.*

CONDITIONS: Given a screening and grinding unit or pictures and drawings of a screening and grinding unit and reference materials, including:

inspection records
manufacturer's maintenance guides
plant drawings and specifications
preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Describe these preventive maintenance procedures for the screening and grinding unit:

Cleaning
- chain
- channel inlet gate
- channel outlet gate
- control section
- drain system
- flushing valve
- flushing water system
- grinder

Lubrication
- chain
- motor
- rake drive
- speed reducer
- sprocket

Mechanical adjustment
- alarm
- bar-screen enclosure
- bar rack
- belt drive
- chain
- channel inlet gate
- channel outlet gate
- grinder
- motor
- rake
- rake-cleaner
- rake drive
- screen belt
- speed reducer
- sprocket

Painting
- bar-screen enclosure
- channel inlet gate
- channel outlet gate
- motor

Replacement
- alarm

Replacement (continued)
- bar-screen enclosure
- bar rack
- belt drive
- chain
- channel inlet gate
- channel outlet gate
- fire-fighting equipment
- first-aid kit
- flushing valve
- flushing water system
- grinder
- limit switch
- motor
- rake
- rake-cleaner
- rake drive
- screen belt
- shaft
- speed reducer
- sprocket

Wear measurement
- bar rack
- belt drive
- chain
- grinder
- motor
- rake
- rake-cleaner
- screen belt
- shaft
- speed reducer
- sprocket

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the screening and grinding unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 3.10: *Perform the preventive maintenance procedures for the screening and grinding unit.*

CONDITIONS: Given a screening and grinding unit and tools and reference materials, including:
- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the screening and grinding unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

INSTRUCTOR ACTIVITY:
1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

STUDENT ACTIVITY:
1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

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OBJECTIVE 3.11: *Describe the corrective maintenance procedures for the screening and grinding unit components listed on page 55.*

CONDITIONS: Given a screening and grinding unit or a mock-up, photographs or drawings of a screening and grinding unit, the manual of operation procedures which the student has

developed for the screening and grinding unit, tools and reference materials, including:
- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides

ACCEPTABLE PERFORMANCE: The student will:

Describe how an operator evaluates each component of the screening and grinding unit for corrective maintenance, commenting on:

capacity	motion
color	odor
corrosion	position
depth	sound
deterioration	temperature
flow	vibration

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the screening and grinding unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

OBJECTIVE 3.12: *Perform the corrective maintenance procedures for the screening and grinding unit components.*

CONDITIONS: Given a screening and grinding unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:
- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the components of the screening and grinding unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

capacity	motion
color	odor
corrosion	position
depth	sound
deterioration	temperature
flow	vibration

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:
1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

STUDENT ACTIVITY:
1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.

3. Perform and explain the corrective maintenance procedures in a treatment plant.

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OBJECTIVE 3.13: *Perform the safety procedures for the screening and grinding unit and demonstrate how they protect employees and visitors.*

CONDITIONS: Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE: The student will:

Identify hazardous conditions in the screening and grinding unit, commenting on:
- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.

INSTRUCTOR ACTIVITY:
1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

STUDENT ACTIVITY:
1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

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OBJECTIVE 3.14: *Compare other screening and grinding units to the mechanically cleaned bubbler unit with grinder (composite model plant unit C).*

CONDITIONS: Given a process unit and reference materials, including:
- equipment catalogues
- laboratory reports
- manufacturer's bulletins
- manufacturer's operation manuals
- plant maintenance and operation records

ACCEPTABLE PERFORMANCE: The student will:

Compare composite model plant unit C with:
- a mechanically cleaned electrode control unit with grinder.
- a mechanically cleaned timer control unit without grinder.
- a mechanically cleaned electrode control unit without grinder.
- a mechanically cleaned float control unit without grinder.
- a mechanically cleaned manual control unit without grinder.
- a mechanically cleaned bubbler control unit without grinder.
- a mechanically cleaned timer control unit with grinder.
- a mechanically cleaned float control unit with grinder.
- a mechanically cleaned manual control unit with grinder.
- a comminution unit.

Consider:
- availability of replacement parts
- capital costs
- dependency on surrounding environment
- ease of repair
- efficiency
- flow-handling capabilities
- maintenance costs
- nuisance to neighbors
- operational costs
- operational skills
- personnel requirements
- reliability
- resistance to upset
- sensitivity of controls
- space requirements
- waste-handling capabilities

INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant unit C with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

STUDENT ACTIVITY:

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

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OBJECTIVE 3.15:

Name and locate the components of the screening and grinding unit listed on page 55. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

CONDITIONS:

Given a screening and grinding unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

contractor's plans of the screening and grinding unit
manufacturer's maintenance guides
operation and maintenance manuals

ACCEPTABLE PERFORMANCE:

The student will:

Name and locate the components of the screening and grinding unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out components of the screening and grinding unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the screening and grinding unit and normal operation procedures.

STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the screening and grinding unit and normal operation procedures.

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OBJECTIVE 3.16: *Perform the abnormal operation procedures for the screening and grinding unit.*

CONDITIONS: Given a wastestream in a treatment plant and reference materials, including:

industrial waste records
operation logs
operator manuals
plant performance guides

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

floating material	level
flow	toxic gases
industrial wastes	

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.

2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

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MODULE 4

GRIT REMOVAL

An aerated unit with bucket elevator

Composite Model Plant Unit D

PURPOSE: *In this module the student will learn to perform all the accivities in the objectives as they apply to an aerated unit with bucket elevator. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

OBJECTIVES:

4.1 *Identify the grit removal unit.*

4.2 *Describe the grit removal process in technical and nontechnical terms.*

4.3 *Describe the safety procedures for the grit removal unit and explain how the procedures protect employees and visitors.*

4.4 *Identify the components of a grit removal unit. Explain the purpose of each component, how the component works and why it is important.*

4.5 *Describe the normal operation procedures for the grit removal unit components listed on page 74.*

4.6 *Perform the normal operation procedures for the grit removal unit.*

4.7 *Describe and perform the start-up and shut-down procedures for the grit removal unit.*

4.8 *Describe the abnormal operation procedures for the grit removal process.*

4.9 *Describe the preventive maintenance procedures for the grit removal unit.*

4.10 *Perform the preventive maintenance procedures for the grit removal unit.*

4.11 *Describe the corrective maintenance procedures for the grit removal unit components listed on page 74.*

4.12 *Perform the corrective maintenance procedures for the grit removal unit components.*

4.13 *Perform the safety procedures for the grit removal unit and demonstrate how they protect employees and visitors.*

4.14 *Compare other grit removal units to the aerated unit with bucket elevator (composite model plant unit D).*

4.15 *Name and locate the components of the grit removal unit listed on page 74. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

4.16 *Perform the abnormal operation procedures for the grit removal unit.*

RESOURCES: 3 116 120 125 141 143 144 202 203 219 220
221 222 223 224 307 308 309 316 317 320 321
324 421 459 511 551 552 553 554 937 990 1033
1034 1399

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OBJECTIVE 4.1: *Identify the grit removal unit.*

CONDITIONS: Given a unit, a model of a unit or a photograph of a unit.

ACCEPTABLE PERFORMANCE: The student will:

Indicate whether the process unit is used for grit removal.

INSTRUCTOR ACTIVITY:

1. Point out characteristics which distinguish the grit removal unit from other process units.

STUDENT ACTIVITY:

1. Develop a picture file of grit removal units. Mark distinguishing characteristics.

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OBJECTIVE 4.2: *Describe the grit removal process in technical and non-technical terms.*

CONDITIONS: Given photographs of the grit removal unit.

ACCEPTABLE PERFORMANCE: The student will:

Describe the grit removal unit, explaining the meaning of:
- grit chamber
- grit collector
- grit removal unit
- grit tank

Describe the purpose of grit removal.

Describe how grit removal affects:
- primary sedimentation
- aeration
- secondary sedimentation
- pond stabilization
- first stage digestion
- second stage digestion
- solids disposal
- flow measurement
- pumping and piping

INSTRUCTOR ACTIVITY:

1. Use diagrams, photographs and slides to describe grit removal.
2. Describe the grit removal process during a plant tour. React to the student's description of the process.

STUDENT ACTIVITY:

1. Describe the grit removal process while viewing photographs, diagrams and slides.
2. Observe and describe the grit removal process during a plant tour.

<<<<<<>>>>>>

OBJECTIVE 4.3: *Describe the safety procedures for the grit removal unit and explain how the procedures protect employees and visitors.*

CONDITIONS: Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE: The student will:

Describe the safety procedures for the grit removal unit, commenting on:
- High-risk activities
  - adjusting moving parts
  - hand removal of grease
  - working in unventilated areas
- Sources of danger
  - air hoses
  - belts
  - electrical equipment
  - moving parts
  - open tanks

Sources of danger (continued)
- slippery walks
- smooth treads
- water hoses
- wet treads

Safety equipment
- life preserver
- protective clothing

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the grit removal unit.
4. Identify sources of danger and high-risk activities pictured in slides.

<<<<<<>>>>>>

OBJECTIVE 4.4: *Identify the components of a grit removal unit. Explain the purpose of each component, how the component works and why it is important.*

CONDITIONS: Given a grit removal unit, unit components or a diagram, model or photographs of a unit and a list of components.

ACCEPTABLE PERFORMANCE: The student will:

Identify components of the grit removal unit and associated equipment:

air filter	baffle
air pressure relief valve	belt

blower	motor mounting
bucket	piping
chain	pressure gage
controller	receiving hopper
coupling	shaft
diffuser	shaft bearing
drain system	shoe
electrical control equipment	silencer
fire-fighting equipment	speed reducer
first-aid kit	sprocket
gate valve	tank
gear box	tightener
guide rail	valve
manifold	weir
motor	

Explain the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.

STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

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OBJECTIVE 4.5: *Describe the normal operation procedures for the grit removal unit components listed on page 74.*

CONDITIONS: Given a grit removal unit or slides or photographs of a grit removal unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

ACCEPTABLE PERFORMANCE: The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

agitation	position
color	sound
corrosion	temperature
motion	velocity
odor	vibration

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:
- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the grit removal process.

List routine calculations for the grit removal process.

Describe routine procedures for recording data.

INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the grit removal unit.
2. Describe the normal operation procedures for the grit removal unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the grit removal unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the grit removal unit and their normal characteristics.
2. Develop a manual of normal operation procedures.

3. Describe the normal operation procedures during a slide show of components of the grit removal unit.
4. Observe and describe the normal operation procedures during a plant tour.

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OBJECTIVE 4.6: *Perform the normal operation procedures for the grit removal unit.*

CONDITIONS: Given a grit removal unit, the manual of normal operation procedures which the student has developed for the grit removal unit and basic references.

ACCEPTABLE PERFORMANCE: The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

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OBJECTIVE 4.7: *Describe and perform the start-up and shut-down procedures for the grit removal unit.*

CONDITIONS: Given a mock-up, model or photograph of a grit removal unit and a grit removal unit with the manufacturer's operation manual.

ACCEPTABLE PERFORMANCE: The student will:

Start up and shut down a grit removal unit, following the manufacturer's instructions.

INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the grit removal unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the grit removal unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

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OBJECTIVE 4.8: *Describe the abnormal operation procedures for the grit removal process.*

CONDITIONS:

Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

floating material	level
flow	septic sewage
grit	settleable matter
ice	suspended solids
industrial wastes	velocity

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:
- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.

4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

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OBJECTIVE 4.9: *Describe the preventive maintenance procedures for the grit removal unit.*

CONDITIONS: Given a grit removal unit or pictures and drawings of a grit removal unit and reference materials, including:
- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Describe these preventive maintenance procedures for the grit removal unit:

Cleaning
- air filter
- air pressure relief valve
- baffle
- blower
- bucket
- chain
- coupling
- diffuser
- drain system
- gate valve
- piping
- receiving hopper
- sprocket
- tank
- weir

Lubrication
- blower
- chain
- coupling
- gear box
- motor
- shaft
- speed reducer
- sprocket
- tightener

Mechanical adjustment
- air pressure relief valve
- baffle
- belt
- blower
- bucket
- chain
- controller
- coupling
- electrical control equipment
- gear box
- guide rail
- motor
- pressure gage
- shaft
- shaft bearing
- silencer
- speed reducer
- sprocket
- tightener
- valve
- weir

Painting
- diffuser

Painting (continued)
- gear box
- manifold
- motor
- motor mounting
- piping
- shaft
- sprocket
- tank

Replacement
- air filter
- air pressure relief valve
- belt
- bucket
- chain
- coupling
- diffuser
- electrical control equipment
- fire-fighting equipment
- first-aid kit
- gear box
- pressure gage
- shoe
- silencer
- speed reducer
- sprocket
- tightener
- valve
- weir

Wear measurement
- belt
- bucket
- chain
- coupling
- gate valve
- shaft
- shoe
- speed reducer
- sprocket
- tightener

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the grit removal unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.

3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

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OBJECTIVE 4.10: *Perform the preventive maintenance procedures for the grit removal unit.*

CONDITIONS: Given a grit removal unit and tools and reference materials, including:
- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the grit removal unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

INSTRUCTOR ACTIVITY:
1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

STUDENT ACTIVITY:
1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

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OBJECTIVE 4.11: *Describe the corrective maintenance procedures for the grit removal unit components listed on page 74.*

CONDITIONS:

Given a grit removal unit or a mock-up, photographs or drawings of a grit removal unit, the manual of operation procedures which the student has developed for the grit removal unit, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides

ACCEPTABLE PERFORMANCE:

The student will:

Describe how an operator evaluates each component of the grit removal unit for corrective maintenance, commenting on:

agitation	position
color	sound
corrosion	temperature
motion	velocity
odor	vibration

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the grit removal unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

OBJECTIVE 4.12: *Perform the corrective maintenance procedures for the grit removal unit components.*

CONDITIONS: Given a grit removal unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the components of the grit removal unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

agitation	position
color	sound
corrosion	temperature
motion	velocity
odor	vibration

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

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OBJECTIVE 4.13: *Perform the safety procedures for the grit removal unit and demonstrate how they protect employees and visitors.*

CONDITIONS: Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE: The student will:

Identify hazardous conditions in the grit removal unit, commenting on:
- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe conditions.

INSTRUCTOR ACTIVITY:
1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

STUDENT ACTIVITY:
1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

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OBJECTIVE 4.14: *Compare other grit removal units to the aerated unit with bucket elevator (composite model plant unit D).*

CONDITIONS: Given a process unit and reference materials, including:
- equipment catalogues
- laboratory reports
- manufacturer's bulletins
- manufacturer's operation manuals
- plant maintenance and operation records

ACCEPTABLE PERFORMANCE: The student will:

Compare composite model plant unit D with:
- an aerated unit with screw conveyor.
- an aerated unit with air lift.
- an aerated unit with clam shovel.
- a velocity control unit with screw conveyor.
- a velocity control unit with bucket elevator.
- a velocity control unit with clam shovel.
- a surface overflow unit with screw conveyor.
- a surface overflow unit with bucket elevator.
- a surface overflow unit with rake.
- a cyclone unit.

Consider:
- availability of replacement parts
- capital costs
- dependency on surrounding environment
- ease of repair
- efficiency
- flow-handling capabilities
- maintenance costs
- nuisance to neighbors
- operational costs
- operational skills
- personnel requirements
- reliability
- resistance to upset
- sensitivity of controls
- space requirements
- waste-handling capabilities

INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the units
2. Compare composite model plant unit D with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

STUDENT ACTIVITY:

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

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OBJECTIVE 4.15: *Name and locate the components of the grit removal unit listed on page 74. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.*

CONDITIONS: Given a grit removal unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

contractor's plans of the grit removal unit
manufacturer's maintenance guides
operation and maintenance manuals

ACCEPTABLE PERFORMANCE: The student will:

Name and locate the components of the grit removal unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out components of the grit removal unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the grit removal unit and normal operation procedures.

STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.
3. Name and select the reference materials which describe the grit removal unit and normal operation procedures.

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OBJECTIVE 4.16: *Perform the abnormal operation procedures for the grit removal unit.*

CONDITIONS:

Given a wastestream in a treatment plant and reference materials, including:

- industrial waste records
- operation logs
- operator manuals
- plant performance guides

ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

floating material	level
flow	septic sewage
grit	settleable matter
ice	suspended solids
industrial wastes	velocity

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:

1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:

1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.
3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

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MODULE 5

PRIMARY SEDIMENTATION

A rectangular unit with telescopic valve drawoff, density meter time clock and trough with scraper

Composite Model Plant Unit E

PURPOSE: *In this module the student will learn to perform all the activities in the objectives as they apply to a rectangular unit with telescopic valve drawoff, density meter time clock and trough with scraper. READ PAGES 1 TO 11 BEFORE USING THIS MODULE.*

OBJECTIVES:

5.1 *Identify the primary sedimentation unit.*

5.2 *Describe the primary sedimentation process in technical and nontechnical terms.*

5.3 *Describe the safety procedures for the primary sedimentation unit and explain how the procedures protect employees and visitors.*

5.4 *Identify the components of a primary sedimentation unit. Explain the purpose of each component, how the component works and why it is important.*

5.5 *Describe the normal operation procedures for the primary sedimentation unit components listed on page 93.*

5.6 *Perform the normal operation procedures for the primary sedimentation unit.*

5.7 *Describe and perform the start-up and shut-down procedures for the primary sedimentation unit.*

5.8 *Describe the abnormal operation procedures for the primary sedimentation process.*

5.9 *Describe the preventive maintenance procedures for the primary sedimentation unit.*

5.10 *Perform the preventive maintenance procedures for the primary sedimentation unit.*

5.11 *Describe the corrective maintenance procedures for the primary sedimentation unit components listed on page 93.*

5.12 *Perform the corrective maintenance procedures for the primary sedimentation unit components.*

5.13 *Perform the safety procedures for the primary sedimentation unit and demonstrate how they protect employees and visitors.*

5.14 *Compare other primary sedimentation units to the rectangular unit with telescopic valve drawoff, density meter time clock and trough with scraper (composite model plant unit E).*

5.15 *Name and locate the components of the primary sedimentation unit listed on page 93. Name and select reference materials*

which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

5.16 Perform the abnormal operation procedures for the primary sedimentation unit.

RESOURCES: 3 116 120 125 141 143 144 202 203 219 220 221 222 223 224 307 308 309 316 317 320 321 324 421 459 511 551 552 553 554 937 990 1033 1034 1399

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OBJECTIVE 5.1: *Identify the primary sedimentation unit.*

CONDITIONS: Given a unit, a model of a unit or a photograph of a unit.

ACCEPTABLE PERFORMANCE: The student will:

Indicate whether the process unit is used for primary sedimentation.

INSTRUCTOR ACTIVITY:

1. Point out characteristics which distinguish the primary sedimentation unit from other process units.

STUDENT ACTIVITY:

1. Develop a picture file of primary sedimentation units. Mark distinguishing characteristics.

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OBJECTIVE 5.2: *Describe the primary sedimentation process in technical and nontechnical terms.*

CONDITIONS: Given photographs of the primary sedimentation unit.

ACCEPTABLE PERFORMANCE: The student will:

Describe the primary sedimentation unit, explaining the meaning of:
- primary basin
- primary clarifier
- "sed" tank
- sedimentation unit

Describe the purpose of primary sedimentation.

Describe how primary sedimentation affects:
- trickling filtration
- aeration
- secondary sedimentation
- pond stabilization
- thickening
- first stage digestion
- second stage digestion
- sludge conditioning
- sludge dewatering
- solids disposal
- effluent disposal
- flow measurement
- pumping and piping

INSTRUCTOR ACTIVITY:
1. Use diagrams, photographs and slides to describe primary sedimentation.
2. Describe the primary sedimentation process during a plant tour. React to the student's description of the process.

STUDENT ACTIVITY:
1. Describe the primary sedimentation process while viewing photographs, diagrams and slides.
2. Observe and describe the primary sedimentation process during a plant tour.

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OBJECTIVE 5.3: *Describe the safety procedures for the primary sedimentation unit and explain how the procedures protect employees and visitors.*

CONDITIONS: Given a list of operation and maintenance procedures.

ACCEPTABLE PERFORMANCE: The student will:

Describe the safety procedures for the primary sedimentation unit, commenting on:

- High-risk activities
  - lifting and lowering objects with ropes and pulleys
  - making adjustments with switch in automatic position
  - raking floating materials from tank surface
  - working inside tank without a buddy
  - working near open pits and tanks
- Sources of danger
  - acid wastes
  - caustic wastes
  - electrical equipment
  - explosive gases
  - falling objects
  - moving parts
  - open pits
  - radiation
  - skimming sprays
  - slippery walks and stairs
  - smooth treads
  - tanks
  - toxic gases
  - water hoses
  - wet treads
- Safety equipment
  - barricades
  - dosimeter
  - explosion proof flashlight
  - first-aid kit
  - handrails
  - ladders
  - life preserver
  - lockout tags and keys
  - protective clothing
  - stair treads

Explain how the procedures protect employees and visitors.

INSTRUCTOR ACTIVITY:

1. Discuss treatment plant case histories.
2. Describe the conditions in a plant and ask for evaluation.
3. Describe the safety procedures for each operation and maintenance procedure.
4. Prepare slides of sources of danger and high-risk activities.

STUDENT ACTIVITY:

1. Read case histories and comment on employee safety procedures.
2. Evaluate conditions which the instructor has described. Suggest remedies.
3. Role play operation or maintenance procedures. Select proper safety equipment and name the sources of danger and high-risk activities. Develop a manual of safety procedures for the primary sedimentation unit.
4. Identify sources of danger and high-risk activities pictured in slides.

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OBJECTIVE 5.4:

Identify the components of a primary sedimentation unit. Explain the purpose of each component, how the component works and why it is important.

CONDITIONS:

Given a primary sedimentation unit, unit components or a diagram, model or photographs of a unit and a list of components.

ACCEPTABLE PERFORMANCE:

The student will:

Identify components of the primary sedimentation unit and associated equipment:

baffle	rail
belt	shaft
chain	shear pin
clutch	shoe
density meter	skimmer arm
drive motor	skimmer trough
fire-fighting equipment	sludge well
first-aid kit	sluice gate
flight	sprocket
gear box	switch gear
grease pit	telescopic valve
influent gate	time clock
limit switch	valve
piping	variable speed drive
pulley	water seal unit
pump	weir

Explain the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out and name components in diagrams, photographs or models.
2. Arrange photographs or models of components in the workshop for student identification.
3. Point out and name components during a plant tour.
4. Question the students about the purpose of each component, how the component works and why it is important.

STUDENT ACTIVITY:

1. Identify the components which the instructor names on diagrams, photographs or models.
2. Identify the components at stations in the workshop in writing.
3. Identify components during a plant tour.
4. Explain the purpose of each component, how the component works and why it is important.

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OBJECTIVE 5.5: *Describe the normal operation procedures for the primary sedimentation unit components listed on page 93.*

CONDITIONS: Given a primary sedimentation unit or slides or photographs of a primary sedimentation unit, a list of components of the unit, a checklist of characteristics and a normal operation procedures manual.

ACCEPTABLE PERFORMANCE: The student will:

Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:

biological growth	position
color	pressure
corrosion	sound
motion	temperature
odor	vibration

Name the sense or indicator which monitors each characteristic.

Explain how often the characteristics of each component must be checked and why the component must be checked on this schedule.

Describe what an operator does if the characteristics of a component indicate that it is not functioning normally, including:
- making adjustments
- deciding about corrective maintenance
- reporting to supervisors
- reporting in written records

Explain why a component's characteristics must be returned to normal.

Describe routine sampling for the primary sedimentation process.

List routine calculations for the primary sedimentation process.

Describe routine procedures for recording data.

INSTRUCTOR ACTIVITY:

1. Describe the characteristics of the components of the primary sedimentation unit.
2. Describe the normal operation procedures for the primary sedimentation unit. Use color pictures.
3. Describe the normal operation procedures during a slide show of components of the primary sedimentation unit.
4. Describe and explain the normal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Develop a checklist, listing the components of the primary sedimentation unit and their normal characteristics.
2. Develop a manual of normal operation procedures.
3. Describe the normal operation procedures during a slide show of components of the primary sedimentation unit.
4. Observe and describe the normal operation procedures during a plant tour.

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OBJECTIVE 5.6: *Perform the normal operation procedures for the primary sedimentation unit.*

CONDITIONS: Given a primary sedimentation unit, the manual of normal operation procedures which the student has developed for the primary sedimentation unit and basic references.

ACCEPTABLE PERFORMANCE: The student will:

Check and evaluate the characteristics of each component, explaining his actions.

Perform the procedures which an operator follows if the characteristics of a component indicate that it is not functioning normally.

Perform the routine sampling.

Perform the routine calculations.

Perform the routine record keeping.

INSTRUCTOR ACTIVITY:

1. Observe the student demonstrating normal operation procedures in a dry run in a treatment plant.
2. Observe the student performing normal operation procedures in a treatment plant.

STUDENT ACTIVITY:

1. Demonstrate the normal operation procedures in a dry run in a treatment plant.
2. Perform and explain the normal operation procedures in a treatment plant.

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OBJECTIVE 5.7: *Describe and perform the start-up and shut-down procedures for the primary sedimentation unit.*

CONDITIONS: Given a mock-up, model or photograph of a primary sedimentation unit and a primary sedimentation unit with the manufacturer's operation manual.

ACCEPTABLE PERFORMANCE: The student will:

Start up and shut down a primary sedimentation unit, following the manufacturer's instructions.

INSTRUCTOR ACTIVITY:

1. Demonstrate and perform the start-up procedures in a treatment plant.
2. Demonstrate and perform the shut-down procedures in a treatment plant.
3. Observe the student performing the start-up procedures in a treatment plant.
4. Observe the student performing the shut-down procedures in a treatment plant.
5. Observe the student as he evaluates his start-up procedures.
6. Observe the student as he evaluates his shut-down procedures.

STUDENT ACTIVITY:

1. Describe the start-up procedures in a dry run in a treatment plant.
2. Describe the shut-down procedures in a dry run in a treatment plant.
3. Perform the start-up procedures in a treatment plant.
4. Perform the shut-down procedures in a treatment plant.
5. Evaluate the operation of the primary sedimentation unit to determine whether correct start-up procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)
6. Evaluate the operation of the primary sedimentation unit to determine whether correct shut-down procedures have been used. Use the normal operation procedures manual which the student has developed. (See objective 1.4.)

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OBJECTIVE 5.8: *Describe the abnormal operation procedures for the primary sedimentation process.*

CONDITIONS: Given a wastestream in a treatment plant or color photographs of a wastestream, a checklist of the conditions of the wastestream and plant records and reference materials.

ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

BOD	level
COD	odor
color	oil
floating material	pH
flow	septic sewage
foam	settleable matter
grease	suspended solids
ice	temperature
industrial wastes	velocity

Describe the cause and effect of the abnormal condition.

Explain how often the condition of the wastestream must be checked.

Describe what an operator does if he observes abnormal conditions, including:
- operational changes
- reporting to supervisors
- sampling procedures

Describe how the actions of the operator will improve the condition of the wastestream.

INSTRUCTOR ACTIVITY:

1. Describe and explain the abnormal conditions of the wastestream illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures during a slide show.
4. Describe and explain the abnormal operation procedures during a plant tour. Listen to the student's description of the procedures.

STUDENT ACTIVITY:

1. Evaluate and explain the abnormal conditions of the wastestream which are illustrated in color pictures.
2. Describe and explain the abnormal operation procedures illustrated in pictures and described in plant records and case histories.
3. Describe and explain the abnormal operation procedures in a class discussion after a slide show.

4. Evaluate and explain the condition of the wastestream during a plant tour. Describe and explain the abnormal operation procedures.

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OBJECTIVE 5.9: *Describe the preventive maintenance procedures for the primary sedimentation unit.*

CONDITIONS: Given a primary sedimentation unit or pictures and drawings of a primary sedimentation unit and reference materials, including:

- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Describe these preventive maintenance procedures for the primary sedimentation unit:

Cleaning
- baffle
- chain
- density meter
- drive motor
- flight
- gear box
- grease pit
- pump
- rail
- skimmer trough
- sludge well
- sluice gate
- telescopic valve
- variable speed drive
- weir

Lubrication
- chain
- clutch
- drive motor
- gear box
- pump
- sprocket
- valve
- variable speed drive

Mechanical adjustment
- baffle
- belt
- chain
- clutch
- density meter
- drive motor
- flight
- gear box
- influent gate
- limit switch
- pulley
- pump
- shaft
- shear pin
- skimmer arm
- sprocket
- switchgear
- telescopic valve
- time clock
- valve
- variable speed drive
- water seal unit
- weir

Painting
- drive motor
- gear box
- piping
- pump
- switchgear
- telescopic valve
- variable speed drive
- weir

Replacement
- baffle
- belt
- chain
- fire-fighting equipment
- first-aid kit
- flight
- shear pin
- shoe
- sprocket

Wear measurement
- belt
- chain
- clutch
- flight
- pump
- rail
- shoe
- skimmer arm
- sprocket
- switchgear

Name the reference materials and tools needed to perform the preventive maintenance procedures.

Explain how often each preventive maintenance procedure must be performed.

Explain how an operator determines whether a component needs preventive maintenance.

Describe what an operator does if a component needs preventive maintenance.

Explain why each preventive maintenance procedure is important.

INSTRUCTOR ACTIVITY:

1. Describe and explain the preventive maintenance procedures for the primary sedimentation unit.
2. Describe and explain the preventive maintenance procedures during a slide show.
3. Describe and explain the preventive maintenance procedures during a plant tour.

STUDENT ACTIVITY:

1. Develop a preventive maintenance schedule and a manual of preventive maintenance procedures.
2. Observe, describe and explain the preventive maintenance procedures during a slide show.
3. Observe, describe and explain the preventive maintenance procedures during a plant tour.

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OBJECTIVE 5.10: *Perform the preventive maintenance procedures for the primary sedimentation unit.*

CONDITIONS: Given a primary sedimentation unit and tools and reference materials, including:
- inspection records
- manufacturer's maintenance guides
- plant drawings and specifications
- preventive maintenance schedule

ACCEPTABLE PERFORMANCE: The student will:

Select the reference materials and tools needed to perform the preventive maintenance procedures.

Apply the preventive maintenance schedule for the primary sedimentation unit, explaining his actions.

Perform the procedures which an operator follows when a component needs preventive maintenance, explaining his actions.

INSTRUCTOR ACTIVITY:
1. Set up simulated situations in the workshop.
2. Observe student inspection of a treatment plant.
3. Observe the student performing the preventive maintenance procedures in a treatment plant.

STUDENT ACTIVITY:
1. Small groups of students perform the preventive maintenance procedures in simulated situations in the workshop.
2. Inspect a treatment plant. Evaluate and explain the preventive maintenance procedures.
3. Perform and explain the preventive maintenance procedures in a treatment plant.

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OBJECTIVE 5.11: *Describe the corrective maintenance procedures for the primary sedimentation unit components listed on page 93.*

CONDITIONS: Given a primary sedimentation unit or a mock-up, photographs or drawings of a primary sedimentation unit, the manual of operation procedures which the student has developed for the primary sedimentation unit, tools and reference materials, including:
- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides

ACCEPTABLE PERFORMANCE: The student will:

Describe how an operator evaluates each component of the primary sedimentation unit for corrective maintenance, commenting on:

biological growth	position
color	pressure
corrosion	sound
motion	temperature
odor	vibration

Explain why a component has malfunctioned.

Name the reference materials and tools needed to perform the corrective maintenance.

Describe what an operator does when he discovers a malfunction, including:
- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Describe how the operator corrects the malfunction.

INSTRUCTOR ACTIVITY:

1. Describe and explain the corrective maintenance procedures for the primary sedimentation unit, using diagrams and pictures.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Describe and explain the corrective maintenance procedures during treatment plant tours.

STUDENT ACTIVITY:

1. Describe and explain the corrective maintenance procedures in situations described or pictured by the instructor.
2. Describe and explain the corrective maintenance procedures during a slide show.
3. Observe, describe and explain the corrective maintenance procedures during a treatment plant tour.

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OBJECTIVE 5.12: *Perform the corrective maintenance procedures for the primary sedimentation unit components.*

CONDITIONS:

Given a primary sedimentation unit or unit components, the operation procedures manual which the student has developed, tools and reference materials, including:

- catalogue of replacement parts
- equipment catalogues
- manufacturer's maintenance guides
- manufacturer's operation manual

ACCEPTABLE PERFORMANCE:

The student will:

Evaluate the components of the primary sedimentation unit for corrective maintenance, explaining why a component has malfunctioned and commenting on:

- biological growth
- color
- corrosion
- motion
- odor
- position
- pressure
- sound
- temperature
- vibration

Select the reference materials and tools needed to perform the corrective maintenance.

Perform the procedures which an operator follows when a component malfunctions, including:

- evaluation of capabilities of plant personnel to perform the procedures
- selection of replacement parts
- record keeping

Correct the malfunction.

INSTRUCTOR ACTIVITY:

1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the components in a treatment plant.
3. Observe the student performing the corrective maintenance procedures in a treatment plant.

STUDENT ACTIVITY:

1. Small groups of students perform and explain the corrective maintenance procedures in simulated situations in the workshop.
2. Evaluate the components for corrective maintenance.
3. Perform and explain the corrective maintenance procedures in a treatment plant.

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OBJECTIVE 5.13: *Perform the safety procedures for the primary sedimentation unit and demonstrate how they protect employees and visitors.*

CONDITIONS: Given a list of operation or maintenance procedures, the student's manual of safety procedures, tools and safety equipment.

ACCEPTABLE PERFORMANCE: The student will:

Identify hazardous conditions in the primary sedimentation unit, commenting on:
- high-risk activities
- sources of danger
- safety equipment

Explain how the procedures protect employees and visitors.

Recommend corrective procedures and correct the unsafe condition.

INSTRUCTOR ACTIVITY:
1. Set up simulated situations in the workshop.
2. Observe the student as he evaluates the safety conditions in a treatment plant.
3. Observe the student performing the safety procedures in a treatment plant.

STUDENT ACTIVITY:
1. Evaluate safety conditions in simulated situations and recommend corrective procedures.
2. Evaluate safety conditions in a treatment plant and recommend corrective procedures.
3. Perform the safety procedures in a treatment plant.

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OBJECTIVE 5.14: *Compare other primary sedimentation units to the rectangular unit with telescopic valve drawoff, density meter time clock and trough with scraper (composite model plant unit E).*

CONDITIONS: Given a process unit and reference materials, including:
- equipment catalogues
- laboratory reports

manufacturer's bulletins
manufacturer's operation manuals
plant maintenance and operation records

ACCEPTABLE PERFORMANCE: The student will:

Compare composite model plant unit E with:
- a circular unit with telescopic valve drawoff, density meter time clock and trough with scraper.
- a rectangular unit with sight glass, direct drawoff and trough with scraper.
- a rectangular unit with sight glass, direct drawoff and helical skimmer.
- a circular unit with sight glass, trough with scraper and direct sludge drawoff.
- a circular unit with sight glass, trough with scraper and telescopic valve drawoff.
- a rectangular unit with helical skimmer and density meter time clock.
- a rectangular unit with helical skimmer and telescopic valve drawoff.

Consider:
availability of replacement parts
capital costs
dependency on surrounding environment
ease of repair
efficiency
flow-handling capabilities
maintenance costs
nuisance to neighbors
operational costs
operational skills
personnel requirements
reliability
resistance to upset
sensitivity of controls
space requirements
waste-handling capabilities

INSTRUCTOR ACTIVITY:

1. Prepare a chart for tabulation of information about the units.
2. Compare composite model plant unit E with the other units.
3. Help the student to collect information for reports on the advantages and disadvantages of each unit.

STUDENT ACTIVITY:

1. List information about the units on a chart.
2. Compare the units in a panel discussion.
3. Write a report on the advantages and disadvantages of each unit.

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OBJECTIVE 5.15:

Name and locate the components of the primary sedimentation unit listed on page 93. Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

CONDITIONS:

Given a primary sedimentation unit, unit components or a diagram, model or photographs of a unit and reference materials, including:

contractor's plans of the primary sedimentation unit
manufacturer's maintenance guides
operation and maintenance manuals

ACCEPTABLE PERFORMANCE:

The student will:

Name and locate the components of the primary sedimentation unit.

Name and select reference materials which explain the normal operation procedures, the purpose of each component, how the component works and why it is important.

INSTRUCTOR ACTIVITY:

1. Point out components of the primary sedimentation unit on diagrams, photographs or models.
2. Listen to the student naming the components and the applicable reference materials during a plant tour.
3. Name and display the reference materials which describe the primary sedimentation unit and normal operation procedures.

STUDENT ACTIVITY:

1. Name the components which the instructor points out on diagrams, photographs or models.
2. Name the components which the instructor points out during a plant tour and name the reference materials which apply to the components.

3. Name and select the reference materials which describe the primary sedimentation unit and normal operation procedures.

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OBJECTIVE 5.16: *Perform the abnormal operation procedures for the primary sedimentation unit.*

CONDITIONS: Given a wastestream in a treatment plant and reference materials, including:
- industrial waste records
- operation logs
- operator manuals
- plant performance guides

ACCEPTABLE PERFORMANCE: The student will:

Evaluate the wastestream for abnormal conditions, commenting on:

BOD	level
COD	odor
color	oil
floating material	pH
flow	septic sewage
foam	settleable matter
grease	suspended solids
ice	temperature
industrial wastes	velocity

Select the references he needs to return the wastestream to normal.

Perform the abnormal operation procedures.

INSTRUCTOR ACTIVITY:
1. Observe the student as he evaluates the wastestream in a treatment plant.
2. Describe the references needed to correct abnormal conditions of the wastestream.
3. Observe the student performing the abnormal operation procedures in simulated situations and in a treatment plant.

STUDENT ACTIVITY:
1. Evaluate the wastestream in a treatment plant.
2. Select the references needed to correct abnormal conditions of the wastestream.

3. Perform the abnormal operation procedures in simulated situations or in a treatment plant.

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